WATER QUALITY MONITORING REPORT

FIRST SEMI-ANNUAL 2010 SAMPLING EVENT

East Carolina Regional Landfill, Permit No. 08-03

Submitted To: East Carolina Environmental
Subsidiary of Republic Services of North Carolina, LLC
1922 Republican Road
Aulander, North Carolina 27805

Submitted By: Golder Associates NC, Inc.
4900 Koger Boulevard, Suite 140
Greensboro, North Carolina 27407

March 2010 **0536-620010.100**

A world of capabilities delivered locally

March 16, 2010 0536-620010.100

Mr. Ray Hoffman, P.E., Area Engineer
Republic Services of NC, LLC
1220 Commerce Street
Conover, North Carolina 28613
828-464-2414

RE: WATER QUALITY MONITORING REPORT, FIRST SEMI-ANNUAL 2010 SAMPLING EVENT EAST CAROLINA REGIONAL LANDFILL, PERMIT NO. 08-07 BERTIE COUNTY, NORTH CAROLINA

Dear Ray:

Golder Associates NC, Inc. (Golder) is submitting this *Water Quality Monitoring Report,* which documents the results of the January 25-26, 2010, compliance monitoring event at the above referenced facility.

Three NC Appendix I inorganic constituents (barium, beryllium, and zinc) were detected above their respective Solid Waste Section Limits (SWSLs) in samples from one or more downgradient compliance monitoring wells during the January 2010 sampling event. None of the concentrations exceeded background concentrations or groundwater standards. Vanadium was detected in the sample from GW-8 at a concentration below the SWSL, but above its Groundwater Protection Standard. No NC Appendix I organic constituents were detected above the SWSLs during this event.

Chromium and zinc were detected above their respective SWSLs, but did not exceed applicable surface water standards in the samples collected from downstream surface water monitoring points SW-2 and SW-4 during the January 2010 event. Inorganic constituent concentrations in SW-2 and SW-4 may be biased high due to entrained sediment in the samples.

Copper and zinc were detected in the sample from the site water supply well above the SWSL, as they have been in previous events and are attributed to the well casing materials. Constituent concentrations reported for the leachate sample collected during the January 2010 sampling event are typical for this facility.

Based on these results, Republic will continue monitoring the uppermost aquifer beneath this facility in accordance with the requirements of the Detection Monitoring Program as outlined in Title 15A NCAC 13B.1633. If you have any questions, please contact the undersigned at 336-852-4903.

GOLDER ASSOCIATES NC, INC.

David “Dusty” Y. Reedy II, P.G.
Senior Project Hydrogeologist

Rachel P. Kirkman, P.G.
Senior Project Geologist

C: Chuck Forth, General Manager, Republic Services, 1922 Republican Road, Aulander, NC, 27805. 252-348-3322.

G:\Projects\Republic\East Carolina\Groundwater\GWMR\January 2010\FINAL E Carolina First Semi-Annual WQMR 2010.docx

EXECUTIVE SUMMARY

Table of Contents

COVER LETTER
1.0 INTRODUCTION 1
1.1 Site Description and Background 1
1.2 Compliance Monitoring History 1
1.3 Hydrogeologic Setting 2
2.0 FIELD PROGRAM, MONITORING RESULTS, AND DISCUSSION 3
2.1 Visual Inspection Program 3
2.2 Well Network and Groundwater Elevation Measurements 4
2.3 January 2010 Groundwater Monitoring Event 4
2.4 Laboratory Analysis Program 5
2.5 January 2010 Sampling Results 5
3.0 LABORATORY AND FIELD QA/QC 6
4.0 DATA EVALUATION 6
4.1 Statistical Evaluations 6
4.2 North Carolina Groundwater and Surface Water Quality Standard Comparisons 6
5.0 CONCLUSIONS 7
6.0 REFERENCES 7

List of Tables

Table 1 Summary of Historical Static Water Level Data for Yorktown Formation
Table 2 Summary of Historical Static Water Level Data for Black Creek Formation
Table 3 Summary of Estimated Horizontal Flow Velocities
Table 4 Summary of Monitoring Well Construction Information
Table 5 Summary of Groundwater Monitoring Results
Table 6 Summary of Surface Water Monitoring Results
Table 7 Summary of Leachate Monitoring Results

List of Drawings

Drawing 1 Groundwater Contour Map, January 25, 2010

List of Appendices

Appendix A Groundwater and Surface Water Sampling Logs
Appendix B January 2010 Groundwater and Surface Water Certificates-of-Analysis, Chain-of-Custody Forms and Laboratory Data Reviews
Appendix C Statistical Evaluation Worksheets and Summary Table

1.0 INTRODUCTION

This report summarizes the monitoring results from the January 25-26, 2010, groundwater, surface water, water supply well, and leachate sampling and analysis event at the East Carolina Regional Landfill in Bertie County, North Carolina in accordance with Title 15A of the North Carolina Administrative Code (NCAC) Subchapter 13B.1632. The East Carolina Regional Landfill, a municipal solid waste landfill, is owned and operated by Republic Services of North Carolina, LLC (Republic) under Permit No. 08-03 issued by the North Carolina Department of Environment and Natural Resources (DENR).

1.1 Site Description and Background

The East Carolina Regional Landfill is an active Subtitle D municipal solid waste landfill that began operating in 1993. As of January 2010, cells 3 through 12 have been constructed. The location of the facility is shown on the inlay on Drawing 1. As presented, the East Carolina Regional Landfill is located approximately 7.5 miles northwest of Windsor, North Carolina at the intersection of State Routes 1221 and 1225. The facility is bounded to the north and east by undeveloped property and the Connaritsa Swamp, to the west by State Route 1225 and undeveloped and agricultural property, and to the south by State Route 1221, wooded property, and undeveloped bottomlands associated with the easterly flowing Cashie River.

Topographic elevations at the facility range from approximately 30 to 70 feet above mean sea level. Along the northern and eastern portions of the facility, surface drainage from the facility and surrounding areas is routed by drainage channels and storm water control structures to tributaries of the southerly flowing Connaritsa Swamp, a tributary system of the Cashie River. Along the western and southern portions of the facility, surface drainage from the facility and surrounding areas is routed by drainage channels and storm water control structures to tributaries of the southeasterly flowing Cashie River. The Cashie River discharges to the greater Roanoke River south of the Town of Windsor.

1.2 Compliance Monitoring History

Groundwater monitoring at the facility was initiated in January 1995 under the Detection Monitoring Program for municipal solid waste landfills. The facility's monitoring network has historically consisted of 14 monitoring wells (GW-1 through GW-14), which monitor the uppermost Yorktown Formation (GW-2, GW-3, GW-5, GW-7 through GW-11, GW-13, and GW-14), and the lower Black Creek Formation (GW-1, GW-4, GW-6, and GW-12). Monitoring wells GW-1 and GW-2 are located upgradient of the landfill, and the remaining wells are located sidegradient or downgradient of the landfill.

In accordance with the facility's permit, the current monitoring network monitors the Yorktown formation and is composed of GW-2, GW-7, GW-8, GW-9, GW-10, GW-11, GW-13, GW-15, GW-16R, and GW-17, with the remaining monitoring wells used for static water level observation. Per the June 2005 revision to the Water Monitoring Procedures (BLE, 2005), the groundwater wells screened in the Black Creek Formation are no longer sampled. Well GW-16 was decommissioned following the July 2007 sampling event during the construction of Cell 12. Bunnell Lammons Engineering, Inc. (BLE) installed monitoring

well GW-16R as a replacement well prior to the January 2008 monitoring event. BLE installed GW-17 following the January 2008 sampling event as an additional downgradient monitoring well during the construction of Cell 12. Monitoring well GW-14 was decommissioned and GW-18 was installed prior to the July 2009 water quality monitoring event in order to construct Cell 13. Piezometer PZ-110 was renamed GW-21 prior to the July 2009 water quality monitoring event. A background sampling event for GW-18 and GW-21 was performed during the July 2009 monitoring event. Wells GW-18 and GW-21 will become part of the compliance network once Cell 13 begins receiving waste. Based on the results of the laboratory and statistical analyses, Republic will continue to maintain a Detection Monitoring Program at this facility.

In addition to the routine groundwater monitoring points, the facility's monitoring network includes one upstream surface water monitoring point (SW-1), and three downstream surface water sampling points (SW-2, SW-3, and SW-4) which are sampled in conjunction with the groundwater monitoring wells. Water supply well PW-1 is sampled during each routine monitoring event. The leachate is also sampled semi-annually per the Solid Waste Section requirements.

1.3 Hydrogeologic Setting

Geologically, the facility is located within the Carolina Coastal Plain Physiographic Province of North Carolina (NCGS 1985). The Coastal Plain Province is generally described as being composed of easterly dipping strata that thicken towards the east. Based on hydrogeologic characteristics, these strata are generally classified as aquifer systems separated by aquitard units. The strata underlying the facility include the Tertiary Yorktown Formation and the Cretaceous Black Creek Formation, both of which are classified as aquifers. The Yorktown Formation is unconfined at this location, and the lower Black Creek Formation, which is separated from the overlying Yorktown Formation by a low permeability unit, is confined.

The uppermost groundwater beneath the facility is present in the shallow, unconfined Yorktown Aquifer. Depending on topographic elevation, the depth to water in the Yorktown Formation ranges from approximately 5 feet below grade along the southwestern perimeter of the facility to approximately 25 feet below grade near the central and northeastern portion of the facility. In the lower Black Creek Formation, the depth to water ranges from 10 to 20 feet below grade in the monitoring wells screened in this unit. Historical static water level data are presented on Tables 1 and 2.

As presented on Table 1, the hydraulic head level in the uppermost Yorktown aquifer beneath the facility is fairly consistent, with temporal variation from the long-term average limited to approximately 6 feet (plus or minus) in the upgradient well and somewhat less in the downgradient wells. Similarly, as presented in Table 2, the fluctuation in the Black Creek aquifer is limited to approximately 4 feet (plus or minus). As expected, the range in fluctuation appears to be greater in the upgradient wells, as these wells are more centrally located to the regional groundwater recharge area. The range in fluctuation in the downgradient

compliance wells, which are generally located near groundwater discharge areas, is less likely due to the stabilizing effect of hydraulic discharge boundaries.

Static water level measurements obtained during the January 25-26, 2010, sampling event were used to prepare the groundwater surface contours presented on Drawing 1. In the upper Yorktown Formation, groundwater flow across most of the site is toward the south-southwest. An apparent groundwater divide is located near the northern cell boundary, and groundwater flow north of the landfill waste boundary is toward the northeast. This is consistent with previously submitted interpretations for this facility. Previous maps of the Black Creek Formation show an apparent flow direction towards the southeast.

Based on the January 25, 2010, groundwater surface contour map for the Yorktown Formation, the hydraulic gradient in the uppermost aquifer underlying the site was measured along the conceptual flow paths shown on Drawing 1. The average hydraulic gradient for the groundwater flowing to the south was calculated to be approximately 0.0041 ft/ft. The hydraulic gradient for groundwater flowing to the north was calculated to be approximately 0.0043 ft/ft. The permeability of the aquifer portion of the Yorktown Formation is estimated to average 3.3E-04 centimeters per second (BLE, 2004). The effective porosity of the shallow aquifer is estimated at 0.27 (BLE, 2004). This information is shown on Table 3.

Using the above values, the estimated rate of groundwater flow for the uppermost aquifer beneath the facility was calculated using the following modified Darcy equation:

$$V_{gw} = Ki/n_e$$

where V_{gw} = average linear velocity (feet per year), K = hydraulic conductivity (feet per year), i = horizontal hydraulic gradient, and n_e = effective porosity.

The average estimated linear groundwater flow velocity under the waste management unit is approximately 5.23 feet per year generally to the south-southwest, which is consistent with previous estimates (Table 3).

2.0 FIELD PROGRAM, MONITORING RESULTS, AND DISCUSSION

Field activities conducted as part of the January 2010 sampling event are discussed in the following sections.

2.1 Visual Inspection Program

In order to ensure that a potential release is detected at the earliest possible time, the visual inspection program is used by sampling crews at the East Carolina Regional Landfill. This program includes physical indicators such as potential water table mounding beneath the waste management unit, physical examination of any stresses in biological communities, visible signs of leachate migration (i.e., leachate seeps), unexplained changes in soil characteristics, and any other change to the environment due to the waste management unit. No physical indicators were observed in the vicinity of the waste management areas during the January 2010 event.

2.2 Well Network and Groundwater Elevation Measurements

The network of groundwater monitoring wells at the East Carolina Regional Landfill consists of GW-2, GW-7, GW-8, GW-9, GW-10, GW-11, GW-13, GW-15, GW-16R, and GW-17, which are screened within the upper Yorktown Formation. Wells GW-18 and GW-21 have been installed, but have not been included as part of the monitoring network at his time. The remaining monitoring wells are used as observation wells to monitor the depth to groundwater. Monitoring well construction information is summarized in Table 4 and the well locations are shown on Drawing 1. The network of monitoring wells was constructed to target the preferential flow path for groundwater underlying waste disposal areas.

Monitoring well GW-2 is the facility's background well and is located hydraulically upgradient of the waste disposal area. Monitoring wells GW-7, GW-8, GW-9, GW-10, GW-11, GW-13, GW-15, GW-16R, and GW-17 are located downgradient or sidegradient of the waste disposal area and represent the facility's downgradient compliance wells.

Depth-to-water measurements were recorded to the nearest 0.01 foot prior to initiating groundwater purging and sampling activities. The water level elevations for this event are presented in Tables 1 and 2.

2.3 January 2010 Groundwater Monitoring Event

Personnel from Golder visited the facility on January 25-26, 2010, to purge and sample monitoring wells GW-2, GW-7, GW-8, GW-9, GW-10, GW-11, GW-13, GW-15, GW-16R, and GW-17. In addition to the groundwater samples from the monitoring wells, a groundwater sample was collected from the on-site water supply well and a leachate sample was collected from the facility's holding tank (Tank B). Additional depth-to-water measurements were obtained from GW-1, GW-3, GW-4, GW-5, GW-6, GW-12, GW-18, and GW-21. Surface water samples were collected from upstream surface water point SW-1 and downstream surface water points SW-2, SW-3 and SW-4 during this event.

Monitoring wells GW-2, GW-7, GW-8, GW-9, GW-10, GW-11, GW-13, GW-15, GW-16R, and GW-17 were purged and sampled using dedicated bladder pumps and micropurge procedures. Measurements of pH, specific conductivity, dissolved oxygen, oxidation-reduction potential, temperature, and turbidity were recorded on approximately 3-minute intervals during the purge, depending on the purge rate. In general, the purge rate for each well was matched to the yield of the monitoring well, as determined by continuously monitoring the depth to water, up to a maximum purge rate of 500 milliliters per minute. Purging was continued until stabilization was indicated by the field parameters. In general, stabilization was deemed to be complete once the range in measured values for the required field parameters was less than 10% per parameter over three monitoring intervals.

Prior to sampling, the laboratory-supplied sample containers were prepared. Each sample container was labeled with the sample identification number, sampling personnel, date and time of sample collection, project name and number, and requested chemical analyses.

The required groundwater samples were collected directly from the dedicated bladder pump discharge lines in the labeled, laboratory-supplied, pre-preserved sample containers after purging was completed based on stabilization of all field parameters. After collection, the samples were placed in a cooler on ice, under chain-of-custody control. Copies of the sampling logs are presented in Appendix A. Included in each log is a description of the sampling location, sampling equipment, sampling method, field observations, and field parameters. During the course of the sampling event, purge water was containerized and disposed of in the facility's leachate collection system.

Surface water samples were collected directly from the stream flow, by lowering the sample containers into the stream flow with the opening facing away from the current flow, taking care to prevent the over flow of the sample containers and to minimize sample-induced turbidity. Measurements of pH, specific conductivity, dissolved oxygen, oxidation-reduction potential, temperature, and turbidity were recorded during the collection of surface water samples.

The leachate sample was collected directly from the leachate piping manifold that serves the leachate holding tank (Tank B). Measurements of pH, specific conductivity, and temperature were recorded during the collection of the leachate sample.

2.4 Laboratory Analysis Program

The January 2010 groundwater, surface water, and leachate samples were received by Environmental Conservation Laboratories, Inc. (ENCO) of Cary, North Carolina on January 26, 2010, under chain-of-custody control for analysis of the NC Appendix I constituents. The leachate sample was also analyzed for the required list of additional parameters.

2.5 January 2010 Sampling Results

Analytical results for the January 2010 groundwater, surface water, and leachate samples are summarized in Tables 5, 6, and 7 with available historical data. The laboratory certificates-of-analysis, chain-of-custody forms, and laboratory data reviews for the sampling event are included in Appendix B.

As presented in Table 5, three inorganic constituents were detected above their respective Solid Waste Section Reporting Limits (SWSLs) in one or more downgradient wells during the January 2010 sampling event. Barium was reported above its SWSL in samples from GW-7, GW-13, GW-15, and GW-17. Beryllium was reported above its respective SWSL in the samples collected from GW-7 and GW-8. Zinc was reported above its SWSL in the sample collected from GW-9. No NC Appendix I organic constituents were reported above the SWSLs during the January 2010 event.

As presented in Table 6, two inorganic constituents (chromium and zinc) were reported above their respective SWSLs in downstream surface water points SW-2 and SW-4 during the January 2010 event. The detections of the two inorganic constituents may be biased high due to entrained sediment in the samples as indicated by relatively high turbidity of both samples. No NC Appendix I organic constituents were detected in surface water points above their respective SWSLs during the event.

Copper and zinc were detected above their SWSLs in the on-site water supply well (PW-1) during the January 2010 event, as they have been during previous events. Zinc is commonly found in water supply wells with galvanized casings, such as PW-1. Constituent concentrations reported for the leachate sample collected during the January 2010 sampling event are typical for leachate at this facility.

3.0 LABORATORY AND FIELD QA/QC

A field blank was collected by Golder personnel as part of the January 2010 monitoring event. In addition to the field blank, a laboratory-prepared trip blank accompanied the NC Appendix I volatile organic compound sample containers to and from the laboratory. ENCO analyzed the field blank for the same constituents as the groundwater samples, and the trip blank for NC Appendix I volatile organic compounds. Also, at least one method blank was analyzed by the laboratory for each method used to analyze groundwater, surface water, and leachate samples. A review of the laboratory data was performed by Golder personnel and is included in Appendix B.

Barium, cadmium, cobalt, lead, silver, and sulfate were detected in method blanks at estimated concentrations. Based on Golder's review of the data, the following concentrations are considered blank-qualified and are appropriately flagged in Tables 5, 6, and 7: the concentrations of cadmium in samples from GW-2, GW-7, GW-9, GW-10, GW-11, GW-13, GW-15, GW-16R, GW-17, SW-1, SW-2, SW-3, SW-4, PW-1, and leachate; cobalt in samples from GW-8, GW-10, GW-11, GW-16R, GW-17, SW-1, SW-3 and PW-1; lead in the sample of leachate; silver in samples from GW-2, GW-7, GW-9, GW-10, GW-11, GW-13, GW-15, GW-16R, GW-17, SW-1, SW-2, SW-3, SW-4, PW-1, and leachate; and sulfate in samples from leachate.

4.0 DATA EVALUATION

The results of the data evaluations are presented in the following sections.

4.1 Statistical Evaluations

Barium, beryllium, and zinc were detected in one or more downgradient monitoring wells above the SWSLs during the January 2010 event. Pursuant to the requirements of 15A NCAC 13B.1633, these concentrations were statistically evaluated in accordance with the procedures outlined in 15A NCAC 13B.1632(g) and (h) to determine if the reported concentrations exceeded the respective facility background concentrations. The statistical worksheets for barium, beryllium, and zinc are presented in Appendix C, including a summary table of the statistical results. As presented, the concentrations of barium, beryllium, and zinc were determined to be below their statistical limits and are not considered statistically significant increases (SSIs) over background.

4.2 North Carolina Groundwater and Surface Water Quality Standard Comparisons

Vanadium was detected at an estimated concentration above the Solid Waste Section Groundwater Protection Standard (GPS) in the sample collected from GW-8 during the event, but was below the SWSL. Chromium and zinc were detected above their respective SWSLs, but did not exceed applicable

surface water standards in the samples collected from SW-2 and SW-4 during the January 2010 event. Inorganic constituent concentrations in SW-2 and SW-4 may be biased high due to entrained sediment in the samples.

5.0 CONCLUSIONS

Based on the results summarized herein, Republic will continue monitoring the uppermost aquifer beneath this facility in accordance with the requirements of the Detection Monitoring Program as outlined in Title 15A NCAC 13B.1633. The next compliance monitoring event for this facility is tentatively scheduled for July 2010.

6.0 REFERENCES

BLE (Bunnell-Lammons Engineering, Inc.), December 2004. *Report of Ground Water Quality Results & Statistical Analysis, Second Semi-Annual Sampling Event of 2004 (N27) East Carolina Regional MSW Landfill, Bertie County, North Carolina.* 5 pp.

BLE (Bunnell-Lammons Engineering, Inc.), 2005. *Water Monitoring Procedures*, *June 2005 Revision.*

Law Engineering, August 1996. Design Hydrogeologic Report Phase II (Cells 7 and 8). 15 pp.

NCGS (North Carolina Geologic Survey), 1985. Geologic Map of North Carolina. Scale 1:500,000.

g:\projects\republic\east carolina\groundwater\gwmr\january 2010\final e carolina first semi-annual wqmr 2010.docx

TABLES

DRAWING

APPENDIX A

GROUNDWATER, SURFACE WATER AND LEACHATE SAMPLING LOGS

APPENDIX B

JANUARY 2010 GROUNDWATER AND LEACHATE CERTIFICATES-OF-ANALYSIS, CHAIN-OF-CUSTODY FORMS AND DATA REVIEWS

APPENDIX C

STATISTICAL EVALUATION WORKSHEETS AND SUMMARY TABLE